A Letter written to the Publiſher by the Learned Mr. Ray, *containing ſome Conſiderations on the Conjecture in* Numb. 114. *of theſe Tracts, about the ſwimming Bladders in Fiſhes.*

This Letter is not mentioned in the Contents, becauſe it was thought at the time when the firſt ſheet was a printing, the Diſcourſe about the precedent Inſtrument would have taken up all the room of this Tract.

SIR,

I was much pleaſed and ſatisfied with the ingenious conjecture I found in your *Tranſactions* of *May* laſt, *pag.* 310. concerning the ſwimming Bladders of Fiſhes; and perſwade my ſelf that the Author thereof hath hit upon their true uſe, *viz.* to ſuſtain or keep them up in any depth of water. For 1. it hath been obſerved by ſome, and I find it in Mr. *Willughbyes* general notes of Fiſhes, that if the ſwimming bladder of any Fiſh be pricked or broken, ſuch a Fiſh ſinks preſently to the bottom, and can neither ſupport nor raiſe up it ſelf in the water. 2. Flat Fiſhes, as *Soles*, *Plaiſe*, &c. which lie alwaies groveling at the bottom, have no ſwimming bladders that I could ever find. 3. In moſt Fiſhes there is a manifeſt channel leading from the gullet or upper orifice of the ſtomach to the ſaid bladder, which without doubt ſerves for conveying air thereinto, as may eaſily be tried by any one that pleaſes. But though air may be received into the bladder, yet is there a valve or ſome other contrivance to hinder the egreſs of it; for you ſhall ſooner break the bladder than force any air out by this channel. Yet in *Sturgeons* Mr. *Willughby* hath obſerved, that preſſing the bladder

bladder, the ſtomach preſently ſwelled: So that it ſeems in that Fiſh the air paſſes freely both wayes. Poſſibly, the Fiſh while alive may have an ability to raiſe up this valve, and let out air upon occaſion, which yet I doubt of, becauſe other Animals have no ſuch faculty of opening any valves made to ſtop the reflux of fluids. But I verily think, there is in the coat of this bladder a muſculous power to contract it when the Fiſh lifts: For, in many Fiſhes it is very thick and opake, like the coat of an Artery (which hath, as Dr. *Willis* obſerves, ſuch a muſcular faculty) as for example in all the Cod-kind; in ſome, v. g. the *Hake*, called in Latin *Merlucius*, it is inwardly covered with a red carneous ſubſtance, which I take to be muſculous fleſh; in others, it is forked at the top, and to each horn hath a muſcle affixed. Now the muſculous force need not be great, being ſtill aſſiſted by the water as the Fiſh deſcends; the preſſure of the water being much greater at the bottom than at the top, as appears by the aſcending bubble. But whereas it is ſaid, Perhaps the Fiſh can by its ſides or ſome other defence keep off the preſſure of the water, and give the air leave to dilate it ſelf: It may be objected, if it can do ſo, what needs then any air-bladder? the cavity of the *abdomen* may ſerve the turn. To which I anſwer, that this power of dilating the *abdomen* by the muſcles may aſſiſt Fiſhes to riſe, whoſe natural place is toward the bottom; and the Air compreſſed in the bladder dilating it ſelf as the Fiſh aſcends, facilitates the action of the muſcles. But thoſe Fiſhes that deſcend by contracting the bladder, letting the contracting muſcle ceaſe to act, will riſe again of their own accord, the Air within dilating it ſelf, as we ſee in glaſs bubbles by compreſſion of the Air in them deſcending, which as ſoon as the force is removed aſcend without more ado. Beſides the flat Fiſhes I before mentioned, all the cartilagineous kind, as well flat as long, want ſwimming bladders: What courſe they uſe to aſcend and deſcend in the water, I know not. Many of the Eel-kind (not all) have ſwimming bladders; yet can they hardly raiſe themſelves in the water, by reaſon of the length and weight of their tails: I ſuppoſe, the Air-bladder being near their heads

heads helps them to lift up their head and fore-part. Great diverſity there is of ſwimming bladders in reſpect of figure, ſubſtance, ſituation and connexion in ſeveral Fiſhes: But not being able to give you any reaſonable account of each, I ſhall forbear to add any thing further of them.

SIR,

Your very humble Servant

Middleton, June 22. 1675.

John Ray.